6049

FREQUENCY METERS

INSTRUCTION MANUAL

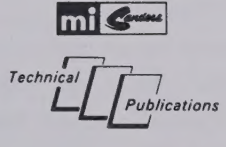
MARCONI INSTRUMENTS LTD
SANDERS DIVISION STEVENAGE

MP MASTER
MA23611

INSTRUCTION MANUAL

for

TYPE 6049 SERIES
FREQUENCY METERS



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SANDERS DIVISION
STEVENAGE HERTFORDSHIRE ENGLAND
A GEC - MARCONI ELECTRONICS COMPANY

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Contents

Chapter 1 GENERAL INFORMATION

1.1 General Information 3
1.2 Specification 4

Chapter 2 OPERATION

2.1 Operating Instructions 5
2.2 Measurements with Optional Accessories 5

Chapter 3 TECHNICAL DESCRIPTION

3.1 Design Details 6
3.2 Component Description 6
3.3 Passing Coaxial Attachment and Stand 6
3.4 Attachment of the Frequency Meter to the Bench Stand 8
3.5 Waveguide Attachments 10

Chapter 4 MAINTENANCE

4.1 Maintenance 11
4.2 Diode Replacement in Crystal Detector 11

Chapter 5 REPLACEABLE PARTS

5.1 Replaceable Parts 12
Ordering 12

ILLUSTRATIONS

Fig.1. Frequency Meters Type 6049/1 and 6049/2 3
Fig.2. Absorption Method of Measurement 5
Fig.3. Transmission Method of Measurement 5
Fig.4. The Type 6049/1 Frequency Meter and Associated Components ... 7
Fig.5. The Type 6049/2 Frequency Meter and Associated Components ... 7
Fig.6. The main body of the 6049/1 detached from the bench stand ... 8
Fig.7. The main body of the 6049/2 detached from the bench stand ... 9
Fig.8. The 6049/1 Frequency Meter mounted to waveguide attachment ... R70, also shown separately 10
Fig.9. The 6049/2 Frequency Meter mounted to waveguide attachment ... R100, also shown separately 11

Chapter 1

General information

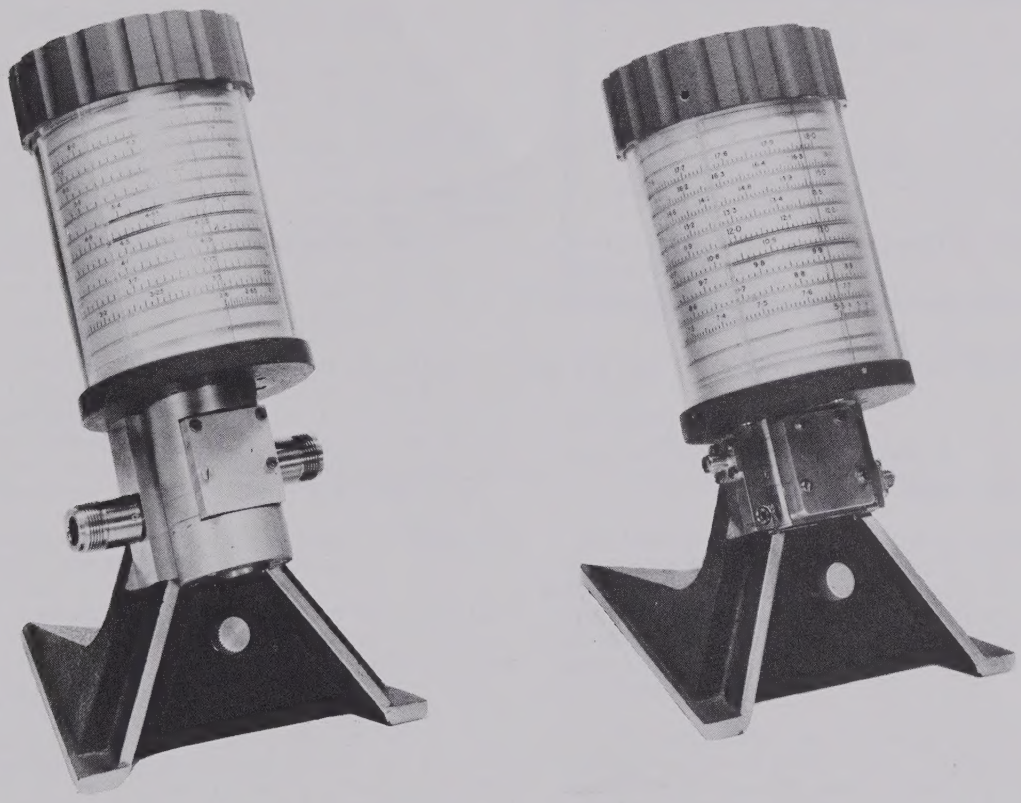

Fig.1. Frequency Meters Type 6049/1 and 6049/2

1.1 GENERAL INFORMATION

The 6049/1 and 6049/2 precision frequency meters have been carefully designed to combine ease of operation with an unusually high standard of measurement accuracy over a very wide frequency range. The 6049/1 covers 2.6 to 8.2GHz, and the 6049/2 covers 5.3 to 18GHz. These instruments have the useful feature that each may be used with its passing coaxial attachment and associated stand (coaxial mount) as an absorption or transmission wavemeter or alternatively may be coupled directly into a waveguide system. The waveguide sizes applicable to each type are given in the lists of optional accessories. The attachments for waveguide sizes R32, R48 and R70 have special flanges that mate with British and American round flanges and also with international rectangular flanges. The attachment for waveguide size R40 mates with flange type CPR229.

In order to achieve the wide band performance, the cavity of the frequency meter is of a hybrid type which will support a mode that is partly coaxial and partly waveguide. Tuning is effected by means of an axial plunger and the entire frequency range is covered without any spurious mode interference.

Frequency is indicated by means of a parallax-free direct-reading spiral dial with an 85 inch scale, whose clarity is compatible with the high order of resolution provided by the high Q of the cavity. Output to an externa metering system may be taken via the auxiliary type N outlet, or alternatively, via an optional BNC outlet incorporating a diode detector. The auxiliary outlet also permits the cavity to be used as a transmission filter.

The attachments are fitted to the frequency meter by means of four captive screws.

When fitted to the bench stand, the spiral scale lies at an angle of 30° from the vertical which facilitates an easy direct readout. In addition an allen key housed in the stand is provided for locking and unlocking the captive screws.

1.2 SPECIFICATION

	6049/1	6049/2
FREQUENCY		
Range	2.6 to 8.2GHz	5.3 to 18.0GHz
Overall accuracy	±0.1% with passing coaxial attachment. ±0.15% with waveguide attachments.	±0.1% with passing coaxial attachment ±0.15% with waveguide attachments
Calibration increments	5MHz between 2.6 and 5.0GHz 10MHz between 5.0 and 8.2GHz	20MHz between 5.3 and 6.0GHz 10MHz between 6.0 and 18.0GHz
INPUT CONDITIONS		
VSWR	Passing coaxial attachment: Less than 1.5 (relative to 50Ω) All waveguide attachments less than 1.1	Passing coaxial attachment with N-type connectors: <2.0(relative to 50Ω) from 5.3 to 12.4GHz Passing coaxial attachment with OSM connectors: <2.0 (relative to 50Ω) from 5.3 to 18.0GHz All waveguide attachments <1.1
RESPONSE		
Q-factor	Typically 1000	Typically 1000
Dip at resonance	Greater than 0.5dB	Passing coaxial attachment: greater than 1.0dB. All waveguide attachments: greater than 0.5dB
Aux.type N outlet	-12dB typical coupling	-22dB typical coupling
Crystal detector	2mV/mW of input signal typical	0.3mV/mW of input signal typical
DIMENSIONS AND WEIGHT	Height 254mm (10in) Weight 2.3kg (5 lb) for frequency meter with coaxial mount	Height 203mm (8 in) Weight 1.6kg(3.6 lb) for frequency meter with coaxial mount

Chapter 2

Operation

2.1 OPERATING INSTRUCTIONS

The standard frequency meter on its coaxial stand may be inserted at any convenient position in a coaxial arrangement taking due care to pad the input to prevent frequency pulling. The frequency is read directly in GHz and resonance may be indicated in one of two basically different ways, namely by (i) absorption or (ii) transmission,

(i) By conventionally observing the resonant dip on an external meter or oscilloscope or

(ii) By using the auxiliary type-N outlet and a crystal detector to sample the power at resonance and indicate this on an external meter. This facilitates measurement of frequency in a through-line system.

Figures 2 and 3 respectively illustrate methods (i) and (ii) of measurement.

The auxiliary N-type outlet may also be used to convert the frequency meter into a simple transmission filter. Note however that the decoupling is either -12dB or -22dB for the 6049/1 or /2 and this will represent a loss if used as a filter. If, during measurement, any N-type outlet is not in use it should be matched by using a coaxial load or pad to prevent any spurious resonances which might result from an open circuit coaxial mismatch.

In normal use the cover plate should always be attached to the frequency meter.

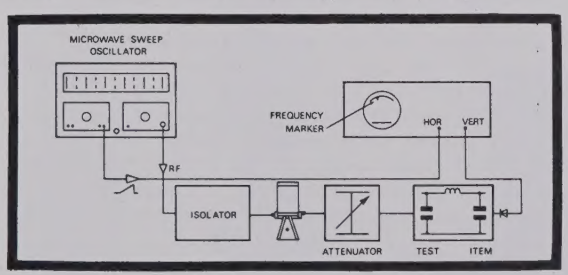

Fig.2. Absorption Method of Measurement

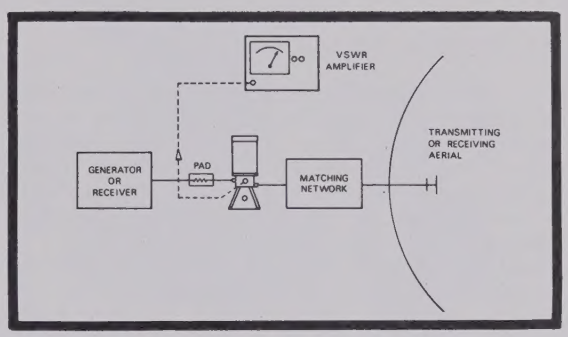

Fig.3. Transmission Method of Measurement

2.2 MEASUREMENTS WITH OPTIONAL ACCESSORIES

A wide range of waveguide attachments is available and may be used with the frequency meter when the main body is detached from its bench stand. These attachments cover all the important waveguide bands from 2.6GHz to 18GHz and are itemised in Chapter 5.

The main body may be detached by unlocking four captive allen screws. An allen key is housed in the bench stand for this purpose. All waveguide attachments are fitted with similar captive allen screws by which the frequency meter is held in intimate contact with the narrow wall of the waveguide. Frequency is measured as discussed in section 2.1.

A crystal detector with BNC connector is an optional auxiliary outlet which may be used to provide a rectified signal of a suitable modulated r.f. signal when the frequency meter is tuned to resonance. The output is then detected by an external metering system.

Chapter 3

Technical description

3.1 DESIGN DETAILS

Both frequency meters consist essentially of high Q cavities which a plunger may move axially. Each cavity is mounted and coupled via a small diameter hole to a passing coaxial attachment which has the property of radiating a small amount of the incident power to the cavity whilst introducing a minimum of mismatch. The cavity may also be mounted on waveguide sections which are supplied as optional extras. These have a coupling hole in their narrow wall to provide a resonant absorption of greater than ½dB.

A second coupling hole in the cavity, which is positioned diametrically opposite the input coupling hole, provides an auxiliary output from the cavity. The output may be taken via the standard N-type connector attachment or via an optional crystal detector with BNC connector. With the former N-type connector attachment the cavity may be used as a transmission filter.

Both cavities are of brass construction and have highly polished surfaces on which are deposited a highly conductive layer of copper and then gold. This results in a high Q, low loss structure. The Q of the cavity with the passing coaxial attachment is typically 1000. The cavity is tuned by a gold plated spindle which passes into the cavity via an r.f. choke section which provides a non-contacting short circuit to r.f. frequencies.

As the spindle is inserted into the cavity it will support a mode of resonance which is a combination of the coaxial T.E.M. and the waveguide TM 010 modes. This mode of resonance has two properties which make it particularly suitable for wide-band frequency applications. The first is that by suitable choice of dimensions, the tuning range of the cavity can cover a frequency band as large as 3.5 to 1 without any spurious mode interference. The second property of the resonant mode is that the tuning law over a large portion of the frequency range is approximately linear.

These two properties of resonant modes have been utilised in the 6049/1 and 6049/2 to produce frequency meters capable of measuring frequency from 2.6GHz to 18.0GHz with a high constant degree of accuracy.

3.2 COMPONENT DESCRIPTION

Figs.4 & 5 illustrates the Type 6049/1 and 6049/2 Frequency Meters mounted on their bench stands and the complete range of waveguide components and auxiliary output attachments. Both instruments are shown with their cover plates attached. These may be removed and the N-type or the crystal detector attachments fitted. The waveguides illustrated are indicated in the photographs.

3.3 PASSING COAXIAL ATTACHMENT AND STAND

The passing coaxial attachments and bench stands of the 6049/1 and 6049/2 instruments are shown in figures 6 and 7. A circular iris in the face of the attachment provides a suitable amount of coupling from the coaxial line to the frequency meters with a minimum of mismatch. In normal operation the passing coaxial attachment is used attached to the stand. However, should it be required to detach the attachment proceed as follows.

For the 6049/1 attachment first unscrew the two cheesehead screws and remove the cover plate which gives access to two large recessed screws. These hold the passing coaxial attachment and the bench stand securely together and can be undone and the components separated, replace the cover plate after separation. The 6049/2 attachment has two small socket head screws located in the rear of bench stand which screw directly into the passing coaxial attachment. These may be undone and the components separated.

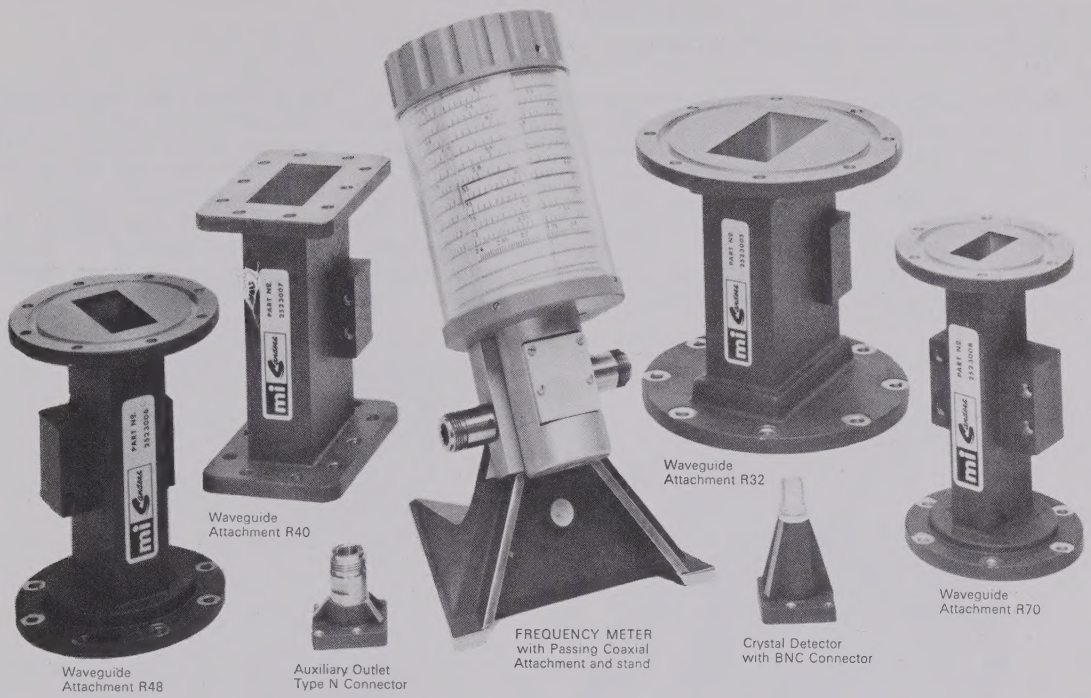

Fig.4. The Type 6049/1 Frequency Meter and Associated Components

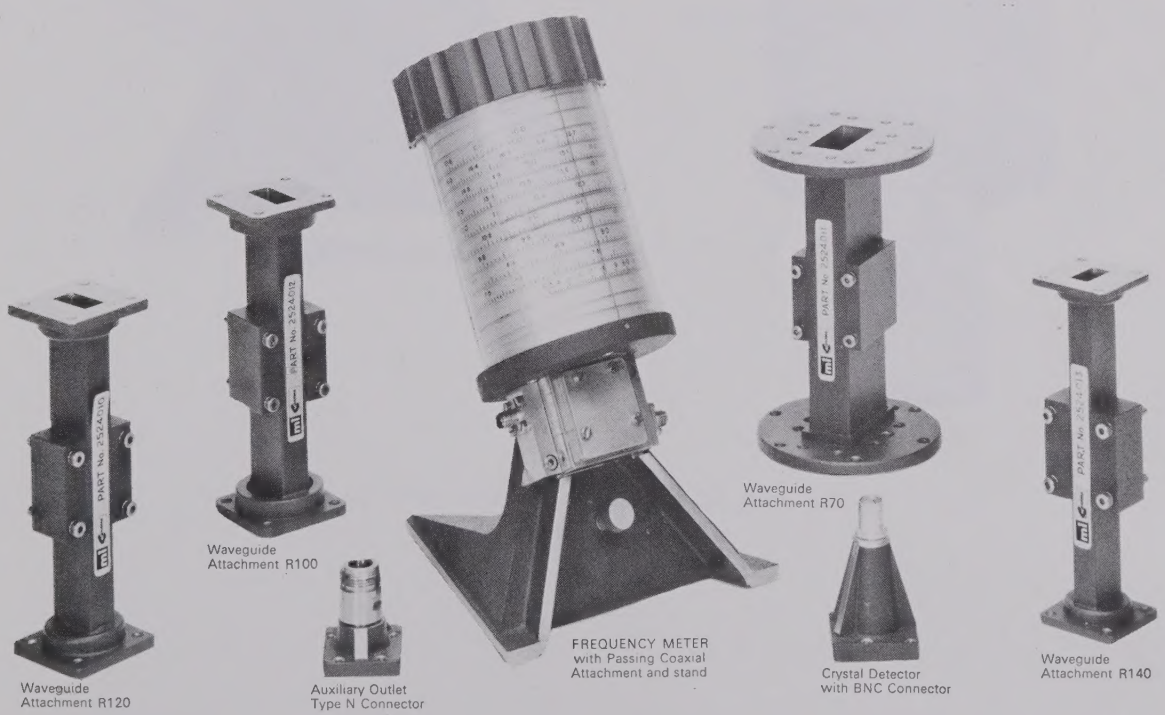

Fig.5. The Type 6049/2 Frequency Meter and Associated Components

3.4 ATTACHMENT OF THE FREQUENCY METER TO THE BENCH STAND

The frequency meters are shown in figures 6 and 7 detached from their respective bench stands. They can be attached by four socket head screws which are held captive in the passing coaxial attachment. An allen key suitable for securing and detaching these screws is housed in the bench stand. All four screws must be tightened uniformly to ensure correct seating of the frequency meter.

Figures 1 and 2 illustrate the frequency meter assembled and ready for use in a coaxial line system. The cover plate on the auxiliary output of the frequency meter may be replaced by the N-type outlet or optional crystal detector. These can only be mounted in their one preferred orientation because of the asymmetrical arrangement of the four mounting holes.

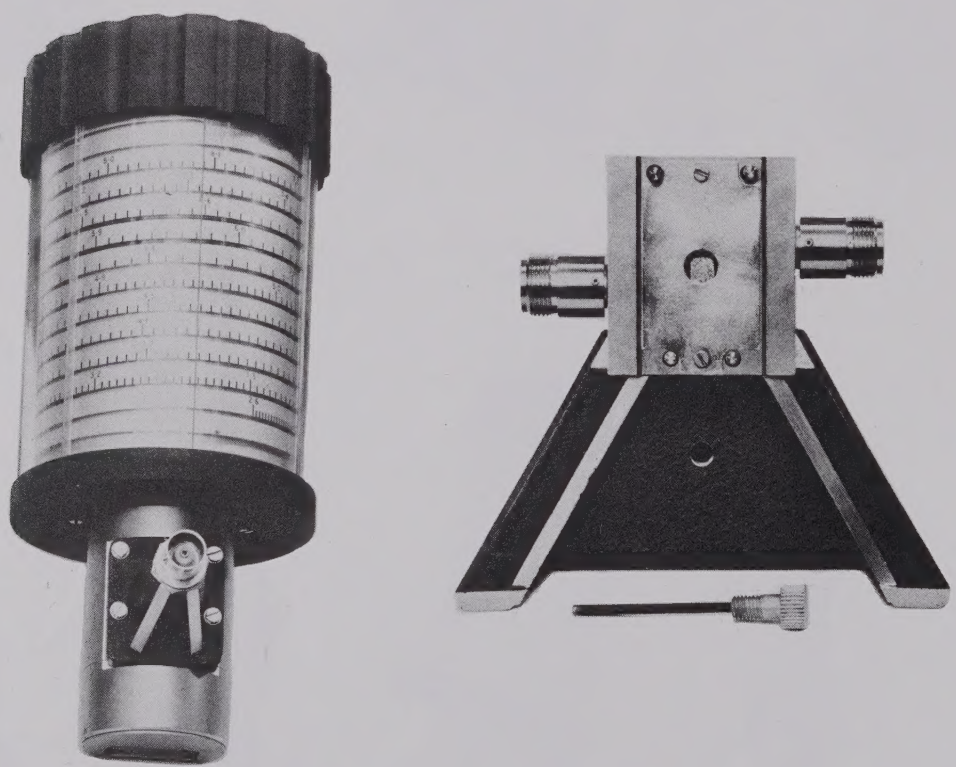

Fig.6. The main body of the 6049/1 detached from the bench stand

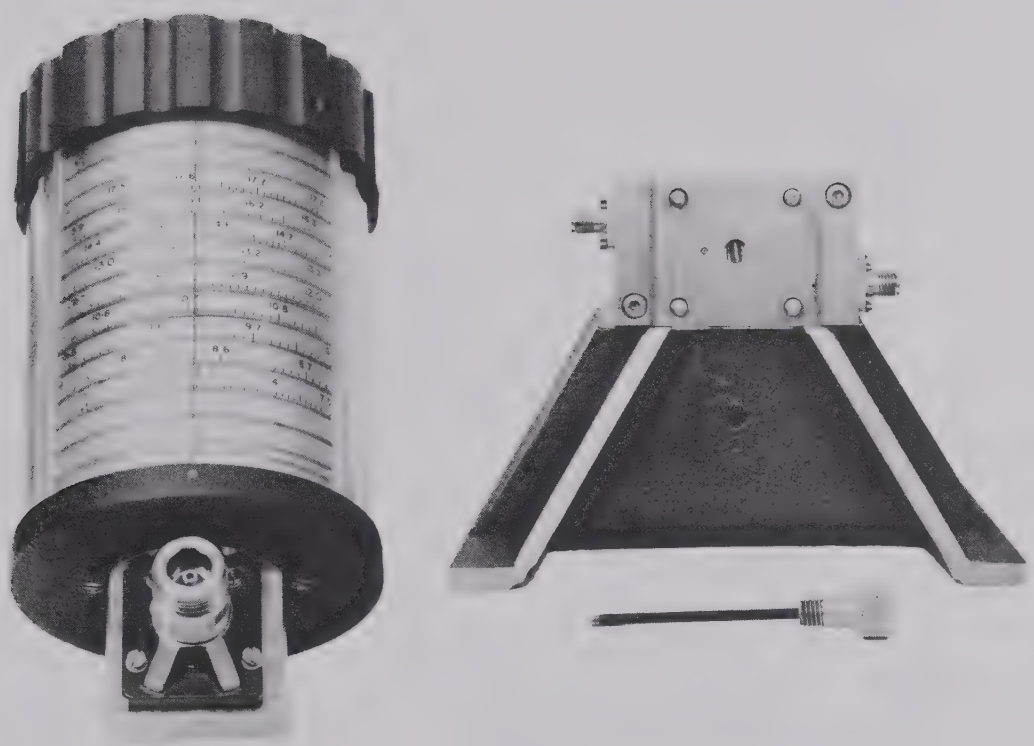

Fig.7. The main body of the 6049/2 detached from the bench stand

3.5 WAVEGUIDE ATTACHMENTS

The frequency meter may also be used in conjuction with four different sizes of waveguide. Figures 8 and 9 illustrate the frequency meter suitably mounted to these. All waveguide attachments are fitted with four captive socket head screws which hold the frequency meter in intimate contact with the narrow wall of the waveguide.

Some waveguide attachments are fitted with dielectric windows to improve the coupling and care must be taken not to insert any blunt implement down the waveguide or into the coupling hole which with enough force might dislodge the dielectric.

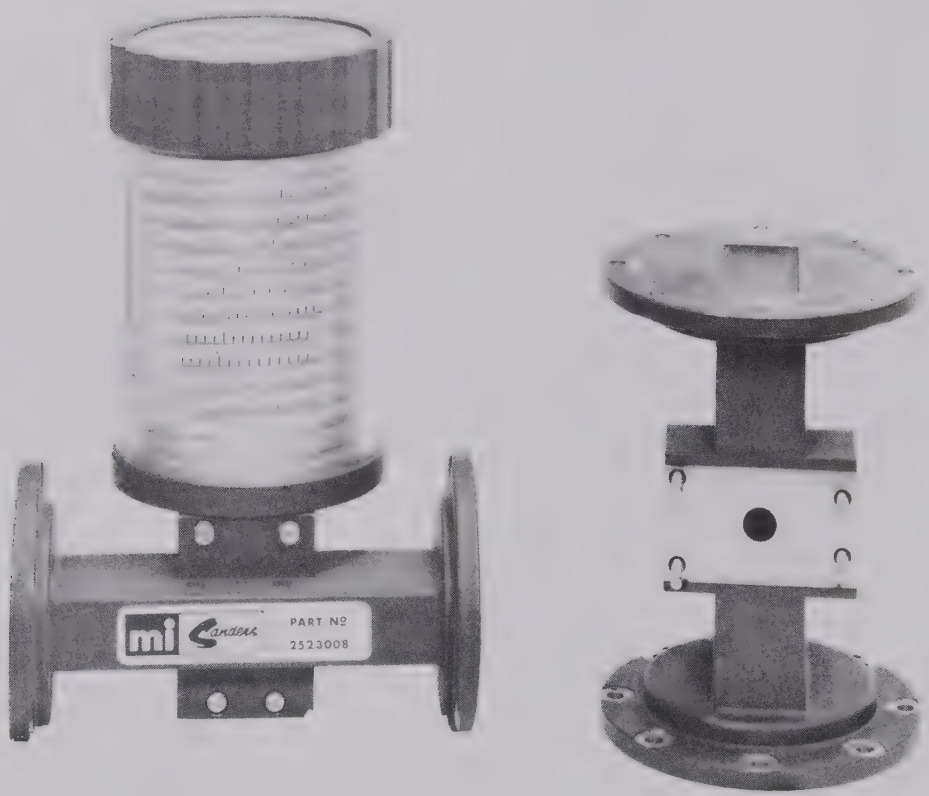

Fig.8. The 6049/1 Frequency Meter mounted to waveguide attachment R70, also shown separately

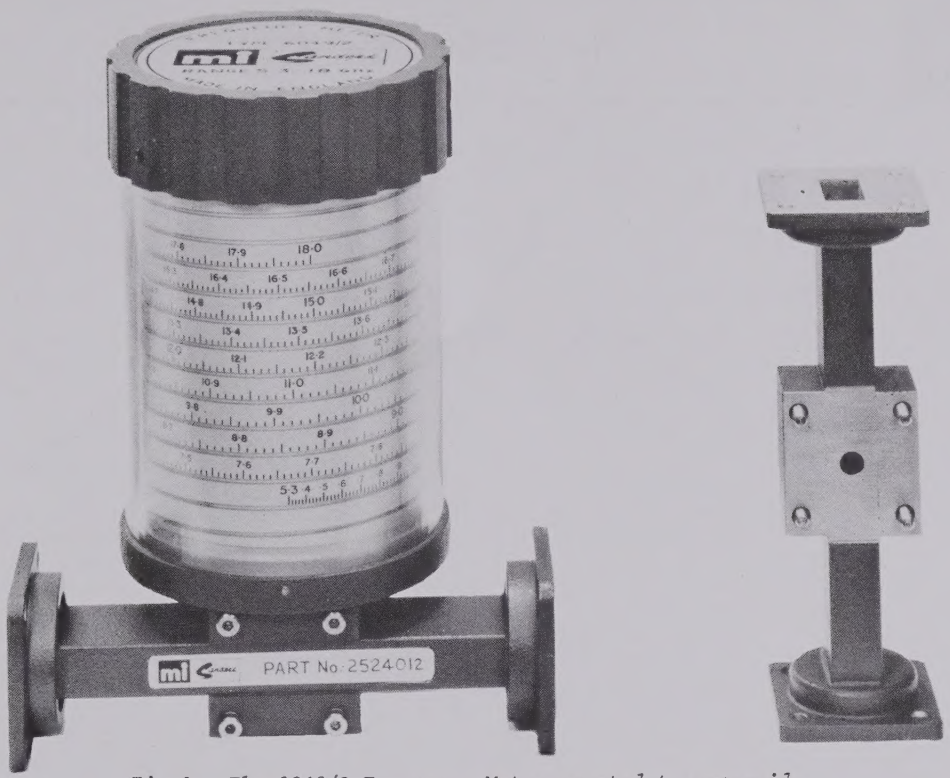

Fig. 9. The 6049/2 Frequency Meter mounted to waveguide attachment R100, also shown separately

Chapter 4

Maintenance

4.1 MAINTENANCE

Because of the complexity of the setting-up procedure it is not recommended that users re-calibrate their own instruments. Although during the normal laboratory life of the instrument it is not anticipated that recalibration will be necessary, should this become so it is recommended that the frequency meter, complete with its bench stand, be returned to the manufacturer.

The 6049/1 and 6049/2 frequency meters are precision instruments and should be treated as such. Due care should be taken when handling them to avoid sudden bumps or knocks which could be detrimental to their calibration or to the smooth tuning movement.

4.2 DIODE REPLACEMENT IN CRYSTAL DETECTOR

The diode in the crystal detector of the 6049/1 frequency meter may easily be replaced with any IN21B diode should this become necessary. This item may be ordered as part No.2523087. Release the nut securing the BNC connector to the body of the detector and unscrew the connector. The diode may then be lifted out, replaced and the unit reassembled.

The diode used in the 6049/2 crystal detector is a specially modified IN26 diode. This item may be ordered as part No.2524060 and replaced as described above.

Chapter 5

Replaceable parts

5.1 REPLACEABLE PARTS

6049/1			6049/2		
ACCESSORIES	part No.	Description	ACCESSORIES	part No.	Description
	2523009	Passing coaxial attachment complete with two female Type 'N' connectors.		2524008	Passing coaxial attachment complete with 2 female O.S.M. connectors.
	2523048	Stand for coaxial attachment		2524047	Stand for coaxial attachment
	2523015	Auxiliary outlet with Type 'N' female connector.		2524030	Auxiliary outlet with type N female connector
	2523041	Cover plate		2524048	Cover plate
	2523008	Waveguide attachment R70 (WG14)		2524009	Passing coaxial attachment complete with 2 female type N connectors
	2523006	Waveguide attachment R48 (WG12)		2524013	Waveguide attachment R140 (WG18)
	2523007	Waveguide attachment R40 (WG11A)		2524010	Waveguide attachment R120 (WG17)
	2523005	Waveguide attachment R32 (WG10)		2524012	Waveguide attachment R100 (WG16)
	2523011	Detector with BNC connector		2524011	Waveguide attachment R70 (WG14)
	2523087	Diode		2524014	Detector with BNC connector
				2524060	Diode

Ordering

Send your order for replaceable parts to our Service Department. Specify the following information for each part required.

(1) Type and serial number of instrument.

(2) Description.

For SERVICE DEPARTMENT ADDRESS
(see back cover)

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